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IMPROVED PROTECTIVE COATINGS FOR SONAR DOMES.(U)
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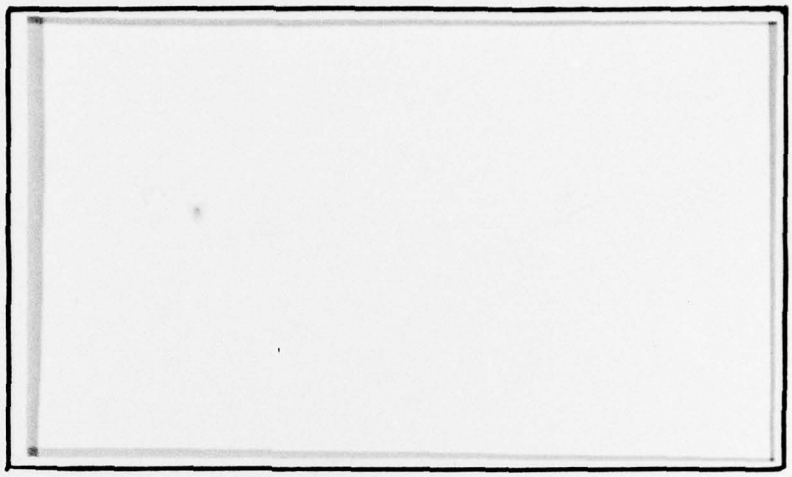

TECHNICAL MEMORANDUM

U.S. NAVAL APPLIED SCIENCE LABORATORY
NAVAL BASE
BROOKLYN I, NEW YORK

(1)

(9) Technical memo.

(6) IMPROVED PROTECTIVE COATINGS
FOR
SONAR DOMES,

Lab. Project 9300-43, Technical Memorandum #1

(16) F44143 (17) SF 001 03 03/ Task 8213

(11) 15 JUL 1964 (12) 19 P.

(14) NASL-9344-43-TM-1

MATERIAL SCIENCES DIVISION

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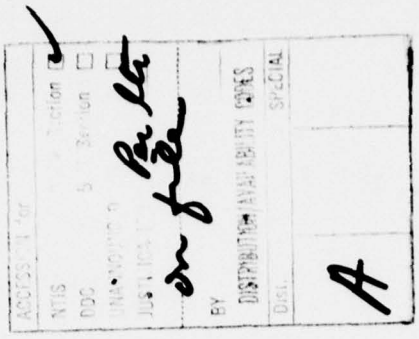

Lab. Project 9300-43
Technical Memorandum #1

Ref: (a) USNUSL Project Order 40016 of 4 Mar 1964
(b) Visit of Messrs. A. W. Cizek, Jr. and N. J. Petito (NAVAPLSCIENLAB, Code 9370) to USNUSL (Code 933) on 18 Mar 1964
(c) NAVAPLSCIENLAB Bill of Lading No. A-4166580 of 24 Mar 1964

Encl: (1) U. S. Naval Applied Science Laboratory Program Summary of 1 May 1964

1. INTRODUCTION

As authorized by reference (a), work has been initiated at the U. S. Naval Applied Science Laboratory on the development of improved protective coatings for sonar domes as outlined in the program summary submitted under enclosure (1). This report discusses the development work now underway at the NAVAPLSCIENLAB.

2. BACKGROUND

The sonar dome surfaces are currently coated with a standard Navy vinyl system consisting of vinyl 119 primer plus 121 antifouling coating applied over 117 pretreatment. The high level acoustic pulse fields generated by current high power sonar systems cause rapid deterioration of these coating systems in service to a state which interferes with the performance of the sonar equipment. As a result, the window area of numerous domes are left uncoated in order to prevent interference with the sonar. Also to prevent accumulation of marine growth, divers are required to periodically clean the metal surfaces. However, since the metal surfaces are uncoated, corrosion is severe. The development of a coating system that has good adhesion, is unaffected by sonic pulsations is acoustically transparent, has good erosion resistance, and has satisfactory anticorrosive and antifouling characterisitcs, is required to overcome the present difficulties.

3. WORK PROGRAM AT NAVAPLSCIENLAB

The following tasks are now underway:

a. A comprehensive review and study is being conducted on the coating systems used for sonar domes to determine the causes and types of failures, and to ascertain to what extent the failures are due to the materials used, the surface preparation, the method of application, and the temperature and humidity conditions under which coatings are applied.

b. Technical representatives of commercial concerns are being inivited to the Laboratory to discuss the problem of coating sonar domes, and are being solicited to submit select samples of anti-corrosive and anti-fouling coatings for our evaluation.

c. Specimens are being prepared using the currently specified vinyl coating system and also an elastomeric coating system previously submitted for test at Dodge Pond. These specimens will be evalauted at the Laboratory and the data will be used as controls for screening new coating systems. The screening for the coating systems will include the following tests:

(1) Resistance to impact, using a G. E. Impact Flexibility Tester as distributed by the Gardner Laboratory, Incorporated which will measure the distensibility of the coating under impact.

(2) Resistance to sonic pulsation using a single SQS26 sonar element.

(3) Resistance to cavitation erosion, using the NAVAPLSCIENLAB rotating disc apparatus.

(4) Resistance to cavitation damage, using the Magnetostriction apparatus developed by Hydronautics, Incorporated.

d. A literature search is being conducted to obtain promising new resins, elastomers, toxics and additives for use in development of sonar dome coating systems by the Laboratory.

e. Arrangements are being made for consultant services for this project with a local university professor who is currently under a Bureau of Ships contract as a coating specialist.

4. TEST PROGRAM AT THE U. S. NAVY UNDERWATER SOUND LABORATORY

In accordance with the agreement made on the occasion of reference (b), only coatings showing promise in the laboratory screening tests will be applied to 5 ft x 5 ft sonar dome sections and forwarded for simulated service evaluation at the Dodge Pond facility. The coatings that show promise in the Dodge Pond tests will then be evaluated for acoustical transparency characteristics at NAVAPLSCIENLAB and for fouling effectiveness at the Marine Test Station in Miami, Florida.

5. Three 5 ft x 5 ft sonar dome sections have been coated with various coating systems and forwarded to the Dodge Pond facility for their evaluation. These coatings have not been checked in the screening tests outlined in paragraph 3c above, but the results to be obtained at Dodge Pond will serve as control data for future tests. The coating systems used are as follows:

a. Navy Standard Vinyl System - One coat of 117 pretreatment primer, 4 coats of 119 vinyl red lead primer, and 2 coats of 121 vinyl red antifouling coating. Metal surface was prepared by sandblasting.

b. Elastomeric Coating System - Twenty brush coats of NASL-C570 neoprene coating applied over sandblasted steel surface primed with one coat of 117 pretreatment and top coated with 2 coats of formula 133 tie coat plus 2 coats of formula 134 rubber antifouling coating.

c. Epoxy Coating System - One coat of Devran 201 coating applied to sandblasted metal surfaces, followed by one coat of Devran 204 coating (manufactured by Devar and Reynolds Company of Newark, New Jersey) and 2 coats of 121 vinyl red antifouling coating. This system was previously found to give somewhat satisfactory performance in shipboard service tests.

The vinyl and elastomeric systems were each applied over entire 5 ft x 5 ft sonar dome sections. The third dome section, forwarded under reference (c), was divided into four equal areas. Two diagonally opposite area, designated as "A" and "D", were coated with the standard Navy vinyl system and the remaining two areas, designated as "B" and "C", with the epoxy coating system. The reverse side of the sonar dome which contains the steel reinforcing structural member, is normally the interior of the dome, and was identically coated in the four equal areas.

6. In order to determine what effect the voids (created by random welding) between the structural members and the skin of the dome has on the deterioration of the coating systems, as discussed on the occasion of reference (b), these voids were filled with an epoxy smoothing compound in the areas of the third dome section, designated as A and B, prior to application of the coating systems. In areas designated as C and D, no smoothing compound was used, but the coating systems were applied carefully in the spaces between the structural members and the dome skin.

7. It is understood that USNUSL will prepare a report on the tests of the coating systems described in paragraph 5 above. The report will also provide a description of the test equipment employed in the tests. The information provided by USNUSL will be correlated with field service date, and will also be useful for guiding the development work of the coating systems.

8. FUTURE WORK

As commercial coatings are made available, they will be screened in the laboratory and promising coating systems will be applied to 5 ft x 5 ft sonar

dome sections for further evaluation at Dodge Pond. As it is understood from discussions with USNUSL personnel on the occasion of reference (b), that the elastomeric coating system as outlined in paragraph 5b above shows an improvement in performance over the standard Navy vinyl system, work at NAVAPLSCIENLAB will continue in the development of an elastomeric coating similar to NASL-C570 which can be readily applied in approximately 4 coats, instead of 20 coats which are impracticable for service application.

U.S. NAVAL APPLIED SCIENCE LABORATORY PROGRAM SUMMARY

BUSHIPS 3920-3	DATE 1 May 1964	TASK SECURITY UNCLASSIFIED

BU. PROG. MGR. 342A	BU. TECH. CODE 634C	SUBPROJECT SF 001-03-03	TASK 8213*

TITLE: Improved Protective Coatings for Sonar Domes

LAB. DIVISION	Material Sciences	D.H. Kallas, Head	CODE 9300	EXT 517
LAB. BRANCH	Coatings	H. Lacks, Head	CODE 9370	EXT 2842

PRINCIPAL LABORATORY INVESTIGATOR: A.W. Cizek, Jr.	FY64	FY 65	FY 66	FY 67	FY 68
INVESTIGATIVE MAN-YEARS	0.5	1.0	1.0	1.0	--
TOTAL DIRECT LABOR MAN YEARS	0.5	1.5	1.1	1.1	--
TOTAL LABOR AND OVERHEAD $K	9.7	28.1	22.3	23.1	--
NORMAL MATERIALS AND TRAVEL $K	0.3	16.9	2.7	1.9	--
MAJOR PROCUREMENTS (over $5K)	0	5.0	0	0	--
PLANNING ESTIMATE $K	10	50	25	25	--

*Work described herein forms part of task 8213 of USNUSL program summary on Hull Dome Problems, which includes funds for the work at NAVAPLSCIENLAB.

Objective: Ultimate objective is to develop a coating system for sonar domes which will have good erosion resistance, have anti-fouling properties, and be able to withstand exposure to high level acoustic pulse fields generated by current high power sonar systems. Specific objectives are:

1. Develop a laboratory test facility for evaluation of coating under simulated service conditions, including sonic pulsation.

2. Develop coatings and screen materials by means of laboratory test facility.

3. Develop adhesive systems for currently available elastomeric anti-fouling coatings.

4. Develop field application techniques for a suitable coating system.

Approach:

Coatings for sonar domes and the problems involved will be discussed and coordinated with the Sonar Dome Study Working Group consisting of representatives of the Bureau of Ships, USNUSL, NEL, DTMB and NAVAPLSCIENLAB.

Laboratory test equipment will be developed to study the cause of adhesion failure and deterioration of anti-corrosive and anti-fouling coating systems currently applied to sonar domes due to high level acoustic fields generated. Water erosion resistance of the coating systems will be determined by the NAVAPLSCIENLAB cavitation resistance apparatus.

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The following coating systems will be investigated:

Selected commercially available anti-corrosive and anti-fouling coating systems having elastomeric properties.

Anti-corrosive and anti-fouling coating systems developed at NAVAPLSCIENLAB based on flexibilized polyurethane and epoxy resins.

Currently available elastomeric anti-fouling coatings applied over adhesive systems developed at NAVAPLSCIENLAB.

The coating systems having desirable adhesion and water erosion resistance as determined by NAVAPLSCIENLAB equipment, will be applied to 5 ft x 5 ft SQS-26 sonar dome test sections for further evaluation at the Dodge Pond facility of USNUSL under full scale sonar acoustic pressure pulses.

Field application techniques will be developed to overcome problems currently encountered in application of coatings to sonar domes, for coating systems found suitable in the Dodge Pond test.

Status: In service, currently applied vinyl coatings, namely 119 primer plus 121 antifouling deteriorate to a state which interferes with the performance of the sonar equipment. In numerous installations, the window areas are now left uncoated so as to prevent interference of the sonar, but divers are required to periodically clean the surfaces of marine growth. In order to overcome this problem, exploratory tests were conducted at the Dodge Pond facility of USNUSL on 5 ft x 5 ft SQS-26 sonar dome test sections coated with the vinyl 119 primer and 121 antifouling coating and also of an elastomeric coating system developed by NAVAPLSCIENLAB. These preliminary tests have shown that the resistance of these coatings to high level underwater acoustic pressure pulses, were dependent on the care taken in applying the coatings, and the relative resilience of the coatings. In this respect the experimental elastomeric coating developed by NAVAPLSCIENLAB showed a slight deterioration after approximately 100 hours of exposure, as compared to approximately 17 hours for the conventional vinyl coating system. However, in view of the 20 coats required for application of the experimental elastomeric coating, the use of this coating is impractical, and will have to be modified to be applied in 3 or 4 coats. Under another project, a study has been conducted on the water erosion resistance or resilient plastic and elastomeric coatings, and a catalog of data is available from which candidate coatings may be selected for possible use in this study. A number of these coatings which are commercially availabe, are applicable in 3 to 4 coats and will be screened at NAVAPLSCIENLAB for further tests at Dodge Pond.

Progress in Preceding Quarter: Work was started during March 1964. Literature search was started. Study was started of promising resins such as polyisobutylenes, vinyls, polyurethanes and chlorinated rubber and neoprene. Conferences were held

with commercial specialists in bottom paints. Impactflexibility tester has been ordered.

Future Plans:

Fiscal Year 1964:

Initiate studies of protective coatings for sonar domes and related adhesive systems. Select some candidate commercially available coatings for screening in laboratory and field tests.

Fiscal Year 1965:

Complete development and construction of NAVAPLSCIENLAB facility for evaluation of coatings for sonar domes, under simulated service conditions, including sonic pulsation.

Select candidate commercially available coatings from a catalog of data available at NAVAPLSCIENLAB of water erosion coatings for screening tests in sonic pulsation equipment.

Initiate laboratory development of protective coatings and related adhesive systems for sonar domes which will be resistant to high level acoustic pressure pulses.

Cooperate with USNUSL in field tests of coatings at Dodge Pond, which have shown promise in NAVAPLSCIENLAB screening tests.

Fiscal Year 1966:

Continue work on selected commercially available coatings, and also continue development of coatings and adhesive systems for use on Sonar Domes.

Cooperated with USNUSL in field tests of coatings at Dodge Pond.

Fiscal Year 1967:

Complete development of coatings and adhesive systems at NAVAPLSCIENLAB, for use on Sonar Domes .

Cooperate with USNUSL in field tests of coatings at Dodge Pond.

Develop field application techniques of coating systems found suitable in tests at Dodge Pond.

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Items of Major Procurement:

Fiscal Year 1965

Contract for acoustic measurements.	5K